Coordination and control – limits in standard representations of multi-reservoir operations in hydrological modeling

Objective

Macro-scale models of hydrologic systems often assume that each reservoir operates independently. However, in many areas, cascades of reservoirs are operated as systems with multiple performance objectives. Rougé et al. (2021) explores the independence assumption for a reservoir cascade.

Approach

Using the Water Balance Model, the study found that parameters controlling upstream reservoir operations reduced the sensitivity of downstream reservoirs. During moderately severe meteorological conditions (a 2011 flood and 2012-2013 drought), the assumption directly resulted in more extreme and adverse hydrologic response in the Upper Snake River of western Wyoming and southern Idaho, USA.

Impact

Rougé et al. (2021) show how the assumption that each reservoir in a cascade system of reservoirs operates independently creates the simulation of artificial drought and flood events, and that a simple representation of coordination can improve the quality of macro-scale hydrologic simulations.

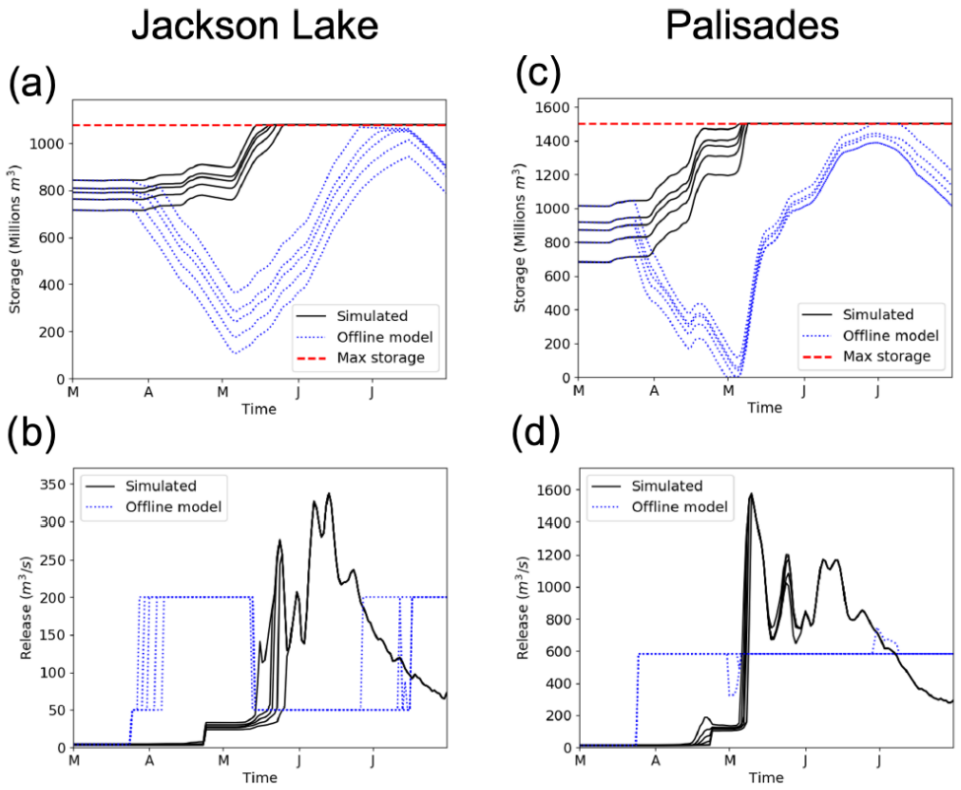

Figure: Results from the coordinated offline reservoir water balance model compared with hydrological model simulation results from non-coordinated operations (including min and max values and quartiles for both ensembles). Differences in storage (a and c for Jackson Lake and Palisades, respectively) are due to a simple coordinated released policy starting in the last week of March (b and d for Jackson Lake and Palisades, respectively).

Rougé, C., Reed, P. M., Grogan, D. S., Zuidema, S., Prusevich, A., Glidden, S., Lamontagne, J. R., and Lammers, R. B.: Coordination and control – limits in standard representations of multi-reservoir operations in hydrological modeling, 25, 1365–1388, https://doi.org/10.5194/hess-25-1365-2021, 2021.